HR-390 Testing of Old Reinforced Concrete Bridges

Key Words: Bridges, Reinforced Concrete, Load Testing, Structures

ABSTRACT

According to data obtained from the National Bridge Inventory (NBI), there are over 12,000 reinforced concrete bridges within the state of Iowa on the county road system. Of these 12,000 bridges, over 1,900 are considered structurally deficient based on traditional analytical rating methods. Current rating practices are based on the procedures outlined in the Manual for Maintenance Inspection of Bridges [I] which typically underestimate the load carrying capacity of existing bridges. Since the cost of replacing all these bridges is prohibitive, a procedure needs to be incorporated which gives a more accurate assessment of each bridges actual safe load carrying capacity. The objective of this research project was to service load test a representative sample of old reinforced concrete bridges (some of them historic and some of them scheduled for demolition so that individual components could be obtained for laboratory testing) with the results being used to create a database so the performance of similar bridges could be predicted.

The types of bridges tested included two reinforced concrete open spandrel arches, two reinforced concrete filled spandrel arches, one reinforced concrete slab bridge, and one two span reinforced concrete stringer bridge. The testing of each bridge consisted of applying a static load at various locations on the bridges and monitoring strains and deflections in critical members. The load was applied by means of a tandem axle dump truck with varying magnitudes of load. At each load increment, the truck was stopped at predetermined transverse and longitudinal locations and strain and deflection data were obtained. The strain data obtained were then evaluated in relation to the strain values predicted by traditional analytical procedures and a carrying capacity of the bridges was determined based on the experimental data.

The response of a majority of the bridges tested was considerably lower than that predicted by analysis. Thus, the safe load carrying capacities of the bridges were greater than that predicted by the analytical models, and in a few cases, the load carrying capacities were found to be three or four times greater than calculated values. However, the test results of one bridge were lower than that predicted by analysis and thus resulted in the analytical rating being reduced. The results of the testing verified that traditional analytical methods, in most instances, are conservative and that the safe load carrying capacities of a majority of the reinforced concrete bridges are considerably greater than what one would determine on the basis of analytical analysis alone.

In extrapolating the results obtained from diagnostic load tests to levels greater than those placed on the bridge during the load test, care must be taken to ensure safe bridge performance at the higher load levels To extrapolate the load test results from the bridges tested in this investigation, the method developed by Lichtenstein [2] in NCHRP Report 12 28(13)A was used.